

California Environmental Protection Agency



Air Resources Board

Spark Ignition Marine ~~Vessel~~Watercraft Evaporative Emissions Test Procedure

TP-1505

**Test Procedure for Determining Pressure Relief Valve Performance:
Durability Demonstration and Leak Test**

Adopted: XXX

TP-1505
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A set of definitions common to all Certification and Test Procedures are in Title 13, California Code of Regulations (CCR), section 2752 et seq. For the purpose of this procedure, the term "CARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the CARB Executive Officer, or his or her authorized representative or designate.

1 APPLICABILITY

This Test Procedure is used by the Air Resources Board to determine the performance of Pressure Relief Valves used to control evaporative emission from Spark Ignition Marine ~~Vessel~~Watercrafts (SIM~~WV~~). SIM~~WV~~'s are defined in Title 13, California Code of Regulations (CCR), section 2850 et seq. This Test Procedure is proposed pursuant to section 43824 of the California Health and Safety Code (CH&SC) and applies to fuel tank or equipment manufacturers seeking an Executive Order for an evaporative control system utilizing a pressure relief valve.

1.1 Requirement to Comply with All Other Applicable Codes and ~~—~~Regulations

Approval of an evaporative emission control component, technology, or system by the Executive Officer does not exempt the same from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

1.2 Safety

This test procedure involves the use of possible hazardous operations and should only be used by or under the supervision of those familiar and experienced in the use of such operations. Appropriate safety precautions should be observed at all times while performing this test procedure.

2 PERFORMANCE STANDARDS

The minimum performance standard for certification of a spark ignition marine watercraft component is defined in CCR Title 13, Chapter 15, Article 4, Section 2855.

3. DURABILITY REQUIREMENT

A durability demonstration is required prior to any testing to determine the performance of a pressure relief valve. These durability tests are designed to ensure that the pressure relief

valve remains effective throughout the useful life of the equipment on which it is being used.

Prior to the commencement of a durability demonstration, the applicant is required to submit and obtain approval of a pressure relief valve durability test procedure. Once approved, a manufacturer is not required to obtain a new approval for a durability demonstration unless changes result in new testing requirements.

Pressure relief valves shall be deemed acceptable if they remain functional after the durability demonstration prescribed below.

The Executive Officer shall review the method based on the following requirements:

(a) Thermal cycle test:

The pressure relief valve is placed in an environment where they are subjected to temperature changes for one cycle as indicated herein: 80°C, 15.5 hours followed by 25 °C, 0.5 hours followed by -40°C, 7.5 hours followed by 25°C, 0.5 hours followed by 50°C, 95%+/- 2% humidity, 15.5 hours followed by 25°C, 0.5 hours followed by -40°C, 7.5 hours and followed by 25°C, 0.5hours. Up to 5 minutes is allowed for the temperature to rise and stabilize. When not specified, the humidity is ambient. Total ten (10) cycles are required.

(b) Pressure/Vacuum Test:

The Pressure/Vacuum test is performed under both high (80°C) and low (-40°C) temperature. Determine the pressure relief valve's design pressure limit (must be at least 7.35 kPa) under normal operating conditions. Connect the pressure relief valve (valve) to a sealed empty tank. Pressurize the empty tank until the valve opens and then evacuate to -2.94 kPa. Flow rates must be no less than 1 L/min. The pressure/vacuum cycling shall be performed at 80°C +/- 3°C ambient with compressed air of no less than 30°C and at -40°C +/- 3°C ambient with compressed air of no higher than 10°C. Repeat the pressure/vacuum process until the valve has been subjected to not less than 8300 cycles in each temperature condition.

(c) Vibration Test:

The vibration test is performed with a vibration frequency of 11 Hz at an acceleration of 59.8 m/s². The valve must be subjected to continuous sinusoidal vibration in its vertical and horizontal (radial and axial) direction for 10⁶ times each.

(d) Dust Test:

The dust test is performed in a test room filled by dust indicated by JIS (Japanese Industrial Standards) Z8901 with a concentration of 30 g/m³. The valve is pressured to open and then close when the tank is evacuated to a maximum of -2.94 kPa +/- 0.1kPa-. Three hundred (300) pressure/vacuum cycles are required.

(e) Ozone Test

The ozone test is a static test performed in an environment that can produce ozone to the specified level and temperature. The pressure relief valve must be subjected to a continuous exposure of 150 ppb +/- 5 ppb (parts per billion) of ozone at 30°C for 120 hours.

4 GENERAL SUMMARY OF TEST PROCEDURE

These test procedures are designed to provide consistent methods to evaluate the durability and the leaking potential of pressure relief valve utilized in SIMV. Any leaking from the pressure relief valve should be devoid under the pressure of 7.35 kPa or less in order to control diurnal evaporative emissions.

The leak test procedure is as follows

- Pressurize the test tank until the pressure relief valve opens. The pressure in the tank should be greater than 7.35 kPa
- Hold the pressure relief valve open for 5 minutes
- Shut off the air and wait for valve to close
- Once the valve closes, hold the pressure in the tank for 16 hours. The final pressure should be equal to or greater than 7.35 kPa. The pressure drop from the beginning to the end of the test should not exceed 5%

5 INSTRUMENTATION

- A fuel tank: 3.0L to 19.0 L, able to withstand 22 kPa
- A pressure gauge: accuracy of <0.1 kPa
- An air pump
- An air mass flow controller: 0-1 L/min range with a minimum accuracy of 0.01 L/min
- An additional air mass flow controller: 0-1 L/min range with a minimum accuracy of 0.01 L/min (optional)
- An air control valve

6 SENSITIVITY AND RANGE

The minimum sensitivity of the pressure gauge, air flow controller and air flow meter must be selected using good engineering judgment.

7 EQUIPMENT CALIBRATIONS

Mass flow controllers and meters must undergo an annual multiple point calibration with a primary standard and have a R^2 coefficient of 0.99 or greater.

8 LEAK TEST PROCEDURE

1. Connect the pressure gauge, the air pump, the mass flow controller, the valve, flow meter and the pressure relief valve to the tank (Figure 2)
2. Pump the air into the tank at a flow rate of 0.1 L/min

3. Record the reading of the flow meter every minute
4. Record the pressure (P_L) when the air begins leaking from the valve. The P_L must be greater than 7.35 kPa
5. When the pressure relief valve is fully open and the air pressure in the tank is stable, record the pressure reading. Hold the pressure for 5 minutes
6. Shut off the valve, and then turn off the pump
7. When the air pressure in the tank becomes stable, record the pressure reading (P_i). The P_i must be equal or greater than 7.35 kPa. Hold the pressure for at least 16 hours.
8. At the end, record the pressure reading (P_e). The P_e must be equal or higher than 7.35 kPa. The difference between P_i and P_e must be less than 5% of P_i .

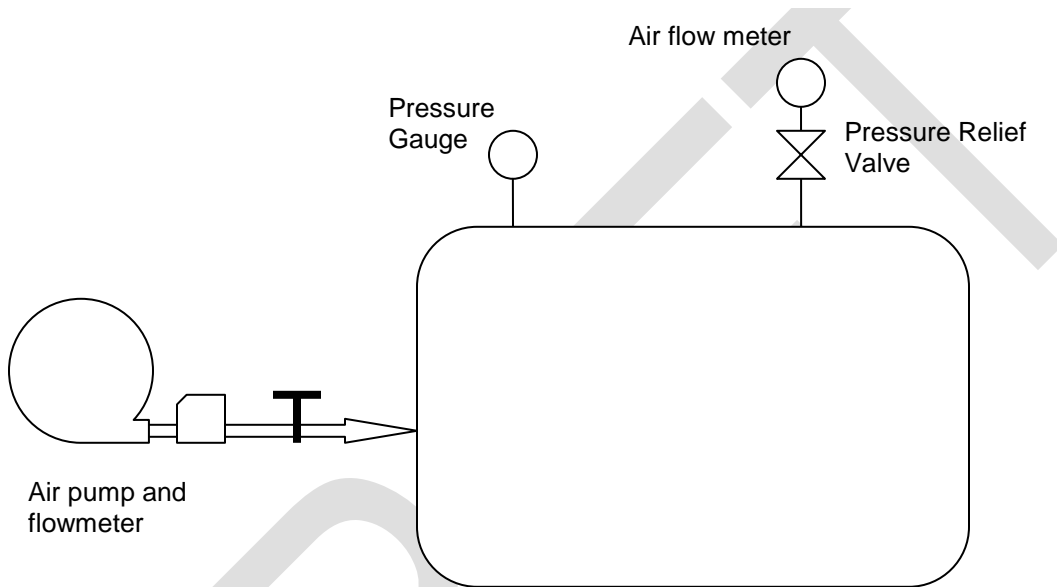


Figure 1: Sketch of pressure relief valve leak testing system

The usage of an air flow meter is optional. Sprayed bubble producing leak detector solution can be used in place of the air flow meter. If using the leak detector solution, the second to fourth step of the above test procedure can be amended to read as follows:

- Pump the air into the tank at a flow rate of 0.1 L/min
- Spray bubble producing leak detector solution on the pressure relief valve
- Record the pressure (P_L) when the air begins leaking from the valve and bubbles are generated. The P_L must be greater than 7.35 kPa

9 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the Executive Officer. In order to secure the ARB Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the ARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

- (1) Documentation of any such approvals and demonstrations shall be maintained by

the ARB Executive Officer and shall be made available upon request.

- (2) Once approved for use, an alternative test procedure may be used and referenced by any manufacturer subject to the limitations and constraints in the Executive Order approving the alternative test procedure.

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